

**Claims**

1. An isolated protein that comprises at least one of 80V, 80tm and 80ct and is free of 80C;

wherein said protein comprises either 80V or 86V or both and

5 optionally comprises one or more of 86C, 80tm, 86tm, 80ct and 86ct wherein:

80V is the variable domain of CD80 or a functional fragment thereof;

86V is the variable domain of CD86 or a functional fragment thereof;

86C is the C domain of CD86 or a functional fragment thereof;

80tm is the transmembrane region of CD80 or a functional fragment thereof;

10 86tm is the transmembrane region of CD86 or a functional fragment thereof;

80ct is the cytoplasmic tail of CD80 or a functional fragment thereof; and

86ct is the cytoplasmic tail of CD86 or a functional fragment thereof.

2. The isolated protein of claim 1 wherein:

80V is the variable domain of CD80;

15 86V is the variable domain of CD86;

86C is the C domain of CD86;

80tm is the transmembrane region of CD80;

86tm is the transmembrane region of CD86;

80ct is the cytoplasmic tail of CD80; and

20 86ct is the cytoplasmic tail of CD86.

3. The isolated protein of claim 1 having the formula:



wherein

R<sup>1</sup> is 0-50 amino acids;

25 R<sup>2</sup> is 80V or 86V;

R<sup>3</sup> is 0-50 amino acids;

R<sup>4</sup> is 86C or 0 amino acids;

R<sup>5</sup> is 0-50 amino acids;

R<sup>6</sup> is 80tm or 86tm;

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R<sup>7</sup> is 0-50 amino acids;

R<sup>8</sup> is 80ct or 86ct; and

R<sup>9</sup> is 0-50 amino acids.

4. The isolated protein of claim 3 wherein:

5 R<sup>1</sup> is 0-25 amino acids;

R<sup>3</sup> is 0-25 amino acids;

R<sup>5</sup> is 0-25 amino acids;

R<sup>7</sup> is 0-25 amino acids; and

R<sup>9</sup> is 0-25 amino acids.

10 5. The isolated protein of claim 3 wherein:

R<sup>1</sup> is 0-10 amino acids;

R<sup>3</sup> is 0-10 amino acids;

R<sup>5</sup> is 0-10 amino acids;

R<sup>7</sup> is 0-10 amino acids; and

15 R<sup>9</sup> is 0-10 amino acids.

6. The protein of claim 1 selected from the group consisting of:

80V/dele/80tm/80ct; 80V/dele/80tm/86ct; 80V/dele/86tm/80ct; 86V/dele/80tm/80ct;

86V/dele/80tm/86ct; 86V/dele/86tm/80ct; 80V/dele/86tm/86ct; 80V/86C/80tm/80ct;

80V/86C/80tm/86ct; 80V/86C/86tm/80ct; 86V/86C/80tm/80ct; 86V/86C/80tm/86ct;

20 86V/86C/86tm/80ct; 80V/86C/86tm/86ct; 80V/dele/80tm/dele; 80V/dele/86tm/dele;

86V/dele/80tm/dele; 80V/86C/80tm/dele; 80V/86C/86tm/dele; 86V/86C/80tm/dele;

86V/86C/80tm/dele; 86V/86C/dele/80ct; 80V/86C/dele/80ct; 80V/dele/dele/80ct;

86V/dele/dele/80ct; 80V/86C/dele/dele; and; 80V.

7. A chimeric protein comprising a protein portion of any of claims 1-6 and an

25 immunogenic portion.

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8. A composition comprising a protein of any of claims 1-7 and an immunogenic protein or a nucleic acid molecule comprising a coding sequence encoding an immunogen, said coding sequence operably linked to regulatory elements.
9. A nucleic acid molecule that comprises a coding sequence that encodes the  
5 protein of any of claims 1-7, said coding sequence operably linked to regulatory elements.
10. A plasmid comprising a nucleic acid molecule of claim 9.
11. A plasmid of claim 10 further comprising a coding sequence encoding an immunogen, said coding sequence operably linked to regulatory elements.
12. A composition comprising a plasmid of claims 10 or 11 further comprising  
10 an immunogenic protein or a plasmid comprising a nucleic acid sequence comprising a coding sequence encoding an immunogen, said coding sequence operably linked to regulatory elements.
13. A recombinant vaccine or attenuated vaccine comprising composition comprising a nucleic acid molecule of claim 9.
- 15 14. A recombinant vaccine composition or attenuated vaccine composition comprising the subject matter of any of claims 1-13.
15. A pharmaceutical composition comprising the subject matter of any of claims  
1-14.
- 20 16. A methods immunizing and individual against an immunogen comprising administering a composition comprising compositions according to any of claims 1-15.
17. The method of claim 16 wherein said immunization is prophylactic.

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18. The method of claim 16 wherein said immunization is therapeutic.
19. The method of claim 16 wherein said immunogen is an allergen.
20. The method of claim 16 wherein said immunogen is a pathogen antigen.
21. The method of claim 16 wherein said immunogen is an antigen associated  
5 with an autoimmune disease.
22. The method of claim 16 wherein said immunogen is an antigen associated with a hyperproliferative disease.
23. An isolated non-CD80 protein comprising at least the C domain of CD80 or a functional fragment thereof.
- 10 24. The isolated non-CD80 protein of claim 23 comprising at least the C domain of CD80.
25. The isolated non-CD80 protein of claim 23 having the formula:
- $$R^1-R^2-R^3-R^4-R^5-R^6-R^7-R^8-R^9$$
- wherein:
- 15  $R^1$  is 0-50 amino acids;  
 $R^2$  is 80V or 86V;  
 $R^3$  is 0-50 amino acids;  
 $R^4$  is 80C;  
 $R^5$  is 0-50 amino acids;
- 20  $R^6$  is 80tm or 86tm;  
 $R^7$  is 0-50 amino acids;  
 $R^8$  is 80ct or 86ct; and  
 $R^9$  is 0-50 amino acids  
wherein

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80V is the variable domain of CD80 or a functional fragment thereof;

86V is the variable domain of CD86 or a functional fragment thereof;

80C is the C domain of CD80 or a functional fragment thereof;

80tm is the transmembrane region of CD80 or a functional fragment

5 thereof;

86tm is the transmembrane region of CD86 or a functional fragment

thereof;

80ct is the cytoplasmic tail of CD80 or a functional fragment thereof;

and

10 86ct is the cytoplasmic tail of CD86 or a functional fragment thereof;

26. The isolated protein of claim 25 wherein:

R<sup>1</sup> is 0-25 amino acids;

R<sup>3</sup> is 0-25 amino acids;

R<sup>5</sup> is 0-25 amino acids;

15 R<sup>7</sup> is 0-25 amino acids; and

R<sup>9</sup> is 0-25 amino acids.

27. The isolated protein of claim 25 wherein:

R<sup>1</sup> is 0-10 amino acids;

R<sup>3</sup> is 0-10 amino acids;

20 R<sup>5</sup> is 0-10 amino acids;

R<sup>7</sup> is 0-10 amino acids; and

R<sup>9</sup> is 0-10 amino acids.

28. The isolated non-CD80 protein of claim 23 having the formula selected from the group consisting of:

25 R-dele-R-80C-R-80tm-R-80ct-R;

R-dele-R-80C-R-80tm-R-dele-R;

R-80V-R-80C-R-80tm-R-dele-R;

R-80V-R-80C-R-dele-R-dele-R;

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R-86V-R-80C-R-80tm-R-80ct-R;

R-86V-R-80C-R-80tm-R-dele-R;

R-86V-R-80C-R-dele-R-dele-R;

R-80V-R-80C-R-86tm-R-80ct-R;

5 R-dele-R-80C-R-86tm-R-80ct-R;

R-dele-R-80C-R-86tm-R-dele-R;

R-80V-R-80C-R-86tm-R-dele-R;

R-80V-R-80C-R-80tm-R-86ct-R;-

R-dele-R-80C-R-80tm-R-86ct-R;

10 R-86V-R-80C-R-86tm-R-80ct-R;

R-86V-R-80C-R-80tm-R-86ct-R;

R-86V-R-80C-R-86tm-R-dele-R;

R-dele-R-80C-R-86tm-R-86ct-R; and

R-86V-R-80C-R-86tm-R-86ct;

15 wherein

80V is the variable domain of CD80 or a functional fragment thereof;

86V is the variable domain of CD86 or a functional fragment thereof;

80C is the C domain of CD80 or a functional fragment thereof;

80tm is the transmembrane region of CD80 or a functional fragment

20 thereof;

86tm is the transmembrane region of CD86 or a functional fragment

thereof;

80ct is the cytoplasmic tail of CD80 or a functional fragment thereof;

86ct is the cytoplasmic tail of CD86 or a functional fragment thereof;

25 dele is 0 amino acids; and

R are each independently 0-100 amino acids.

29. The isolated non-CD80 protein of claim 28 wherein R are each independently 0-50 amino acids.

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30. The isolated non-CD80 protein of claim 28 wherein R are each independently 0-30 amino acids.
31. The isolated non-CD80 protein of claim 28 wherein R are each independently 0-20 amino acids.
- 5 32. The isolated non-CD80 protein of claim 23 selected from the group consisting of:
- a mutant CD80 with the variable domain deleted
  - a mutant CD80 with the variable domain deleted and the cytoplasmic tail deleted.
  - 10 a mutant CD80 with the cytoplasmic tail deleted.
  - a mutant CD80 with the transmembrane region deleted and the cytoplasmic tail deleted.
  - a mutant CD80 with a CD86 variable domain substituted in place of the CD80 variable domain
  - 15 a mutant CD80 with a CD86 variable domain substituted in place of the CD80 variable domain and the cytoplasmic tail deleted.
  - a mutant CD80 with a CD86 variable domain substituted in place of the CD80 variable domain and the transmembrane region deleted and the cytoplasmic tail deleted.
  - 20 a mutant CD80 with a CD86 transmembrane region substituted in place of the CD80 transmembrane region.
  - a mutant CD80 with the variable region deleted and a CD86 transmembrane region substituted in place of the CD80 transmembrane region.
  - a mutant CD80 with the variable region deleted, the cytoplasmic tail deleted
  - 25 and a CD86 transmembrane region substituted in place of the CD80 transmembrane region.
  - a mutant CD80 with the cytoplasmic tail deleted and a CD86 transmembrane region substituted in place of the CD80 transmembrane region.
  - a mutant CD80 with a CD86 cytoplasmic tail substituted in place of the CD80 cytoplasmic tail.

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a mutant CD80 with the variable region deleted and a CD86 cytoplasmic tail substituted in place of the CD80 cytoplasmic tail.

5 a mutant CD80 with a CD86 variable domain substituted in place of the CD80 variable domain and a CD86 transmembrane region substituted in place of the CD80 transmembrane region.

a mutant CD80 with a CD86 variable domain substituted in place of the CD80 variable domain and a CD86 cytoplasmic tail substituted in place of the CD80 cytoplasmic tail.

10 a mutant CD80 with a CD86 variable domain substituted in place of the CD80 variable domain and a CD86 transmembrane region substituted in place of the CD80 transmembrane region and the cytoplasmic tail deleted.

a mutant CD80 with the variable domain deleted and a CD86 transmembrane region substituted in place of the CD80 transmembrane region and CD86 cytoplasmic tail substituted in place of the CD80 cytoplasmic tail.

15 a mutant CD80 with a CD86 variable domain substituted in place of the CD80 variable domain and a CD86 transmembrane region substituted in place of the CD80 transmembrane region and CD86 cytoplasmic tail substituted in place of the CD80 cytoplasmic tail.

20 33. A nucleic acid molecule that comprises a coding sequence that encodes the protein of any of claims 23 to 32 said coding sequence operably linked to regulatory elements.

34. A plasmid comprising a nucleic acid molecule of claim 33.

35. A composition comprising a plasmid of claim 34 and/or a protein of any of claims 23 to 32.

25 36. A recombinant vector comprising composition comprising a nucleic acid molecule of claim 33.



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37. A pharmaceutical composition comprising the subject matter of any of claims 23-36.

38. A methods immunosuppressing an individual comprising administering a  
5 composition comprising compositions according to any of claims 23-37.

39. The method of claim 38 wherein said individual has an autoimmune disease.

40. The method of claim 38 wherein said individual has had, is undergoing or is about to undergo a transplant procedure.